Rla-2-16(T)

SOLID ROCKET PLANT

LMSC PURCHASE ORDER NO. 18-10277

POLARIS PROPULSION DEVELOPMENT

BURST TEST OF A FIRST-STAGE POLARIS
A3 FILAMENT-WOUND CONFIGURATION-X
CHAMBER

PN D-1971249 SN 71-7041 AGC
69 STU

Report No. B-235 15 February 1963

AEROJET
GENERAL TIRE
GENERAL

AEROJET-GENERAL CORPORATION

SACRAMENTO, CALIFORNIA

UNCLASSIFIED/UNLIMITED

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AEROJET-GENERAL CORPORATION
A SUBSIDIARY OF THE GENERAL TIRE & RUBBER COMPANY

ABSTRACT

A first-stage POLARIS A3 filament-wound configuration-X chamber was hydrostatically tested to burst to determine the structural strength of the unit and the mode of failure. The test was terminated after 25 sec of a 1-min hold period at 940 psig when the aft head ruptured. The rupture originated at the aft skirt-to-cylinder juncture.

PREFACE

This report has been prepared by J. W. Oliver, Test Engineer, Polaris Test Engineering Section.

TABLE OF CONTENTS

FIGURE LIST

APPENDIX

I. INTRODUCTION

A first-stage POLARIS A3 filament-wound configuration-X chamber was hydrostatically tested on 29 December 1962 in accordance with structures Test Plan 678P. This test was conducted to further investigate the performance of a series of chambers that had been fabricated by Aerojet-General, Azusa, Calif., with longitudinal roving of low strand strength. The average strand strength of the roving used in this unit was 318,000 psi.

The loads acting on the nozzle plugs during pressurization were partially transferred to the forward skirt to simulate static-firing conditions.

II. SUMMARY

The test was terminated after 25 sec of a planned 60-sec hold at 940 psig when the aft head ruptured in the skirt-to-cylinder juncture area. At time of failure, an axial load of about 89,000 lb was acting on the forward skirt.

Specific test data recorded at 940 psig were:

Maximum longitudinal (skirt-to-skirt) growth of the chamber, in.	1.92 (average of 4 readings)
Maximum forward dome-to-skirt growth, in.	0.89
Maximum aft dome-to-skirt growth, in.	0.43
Circumferential growth of the chamber, in.	
at the midsection of the cylinder	2.75
at the aft tangent point	1.28
at the forward tangent point	1.34

III. DESCRIPTION OF TEST UNIT

The test unit was a first-stage POLARIS A3 filament-wound configuration-X chamber (PN D-1971249, SN 71-7041) that had been manufactured by the Aerojet-General Corp., Azusa, Calif. of low-strength glass roving. The weight of the chamber was 1455 lb.

IV. TEST PROCEDURES

The chamber was tested, aft head down, in a vertical position. Special test plugs were placed into the nozzle ports to unload the bosses by transferring part of the pressure load to the forward skirt and thus to simulate actual firing conditions.

Two contact microphones were placed on the cylindrical portion of the test unit; one microphone was connected to a tape recorder and the other to a sound-level recorder. The chamber was instrumented as shown in Figure 1. All data except the sounds emanating from the chamber were recorded on oscillographic recorders.

The unit was filled with water and pressurized to burst at a rate of about 500 psi/min.

V. TEST RESULTS

The chamber burst after 25 sec of a planned 1-min hold, at a pressure of 940 psig. The failure originated at the aft skirt-to-cylinder juncture.

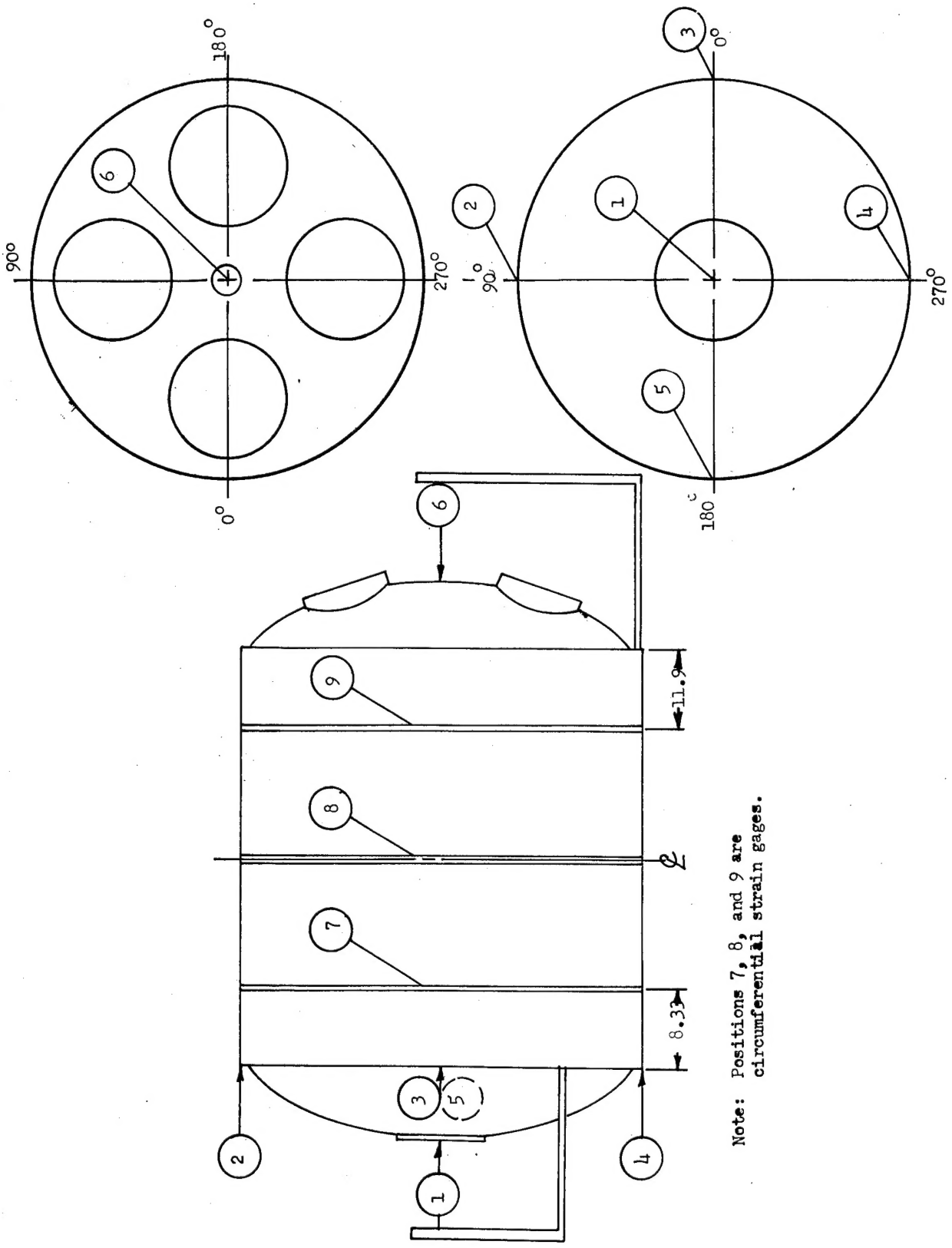
The longitudinal (skirt-to-skirt) growth recorded during the test is graphically shown in Figure 2; a maximum of 1.92 in. was recorded.

Growth data for the forward and aft domes relative to their skirts are shown in Figures 3 and 4, respectively. The maximum growth of the forward and aft domes was 0.89 and 0.43 in., respectively.

Circumferential growth data, recorded at the forward and aft tangent planes and at the midsection of the chamber, are shown in Figure 5. The maximum growth at the midsection of the chamber was 2.75 in. which corresponds to a strain rate of 8,600 microinches/in./min. No valid sound data were obtained because the recording equipment malfunctioned. A view of the ruptured chamber is shown in Figure 6.

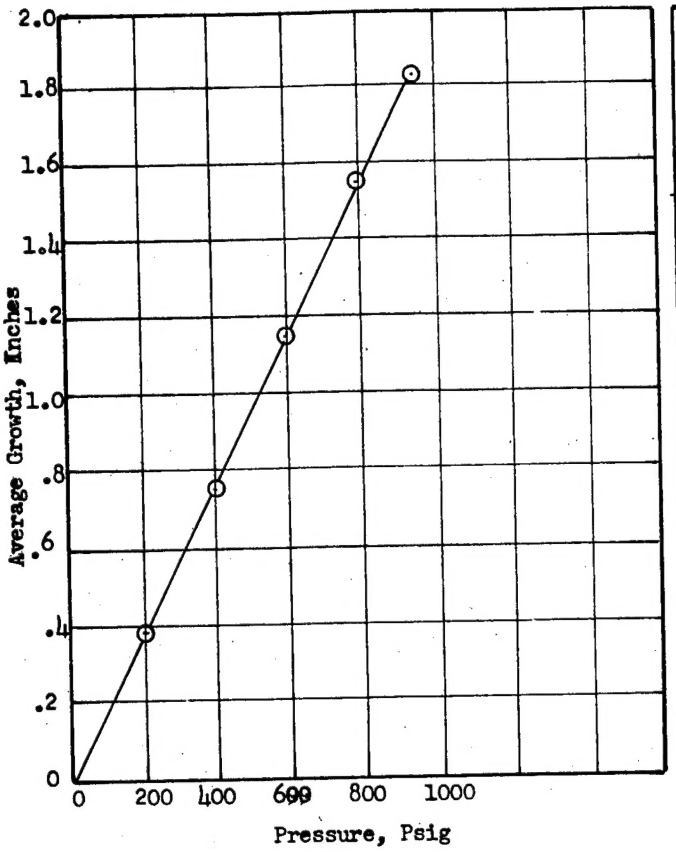
VI. DISCUSSION

The burst of the unit during the 1-min hold was anticipated because of the low strand strength exhibited by the roving that had been used in the fabrication of this chamber.

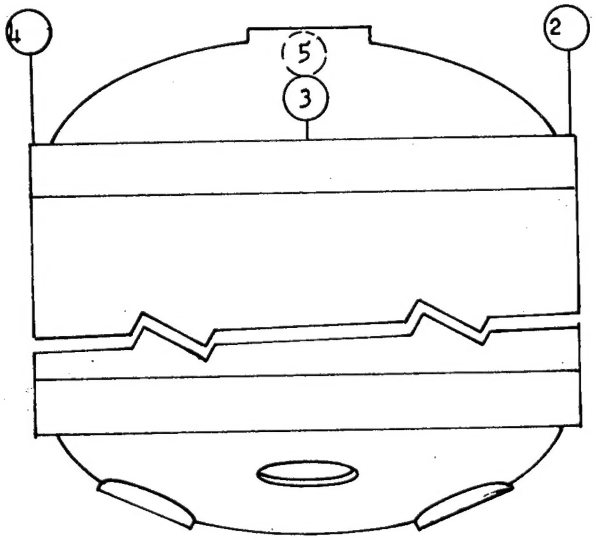


Location of Instrumentation

Figure 1

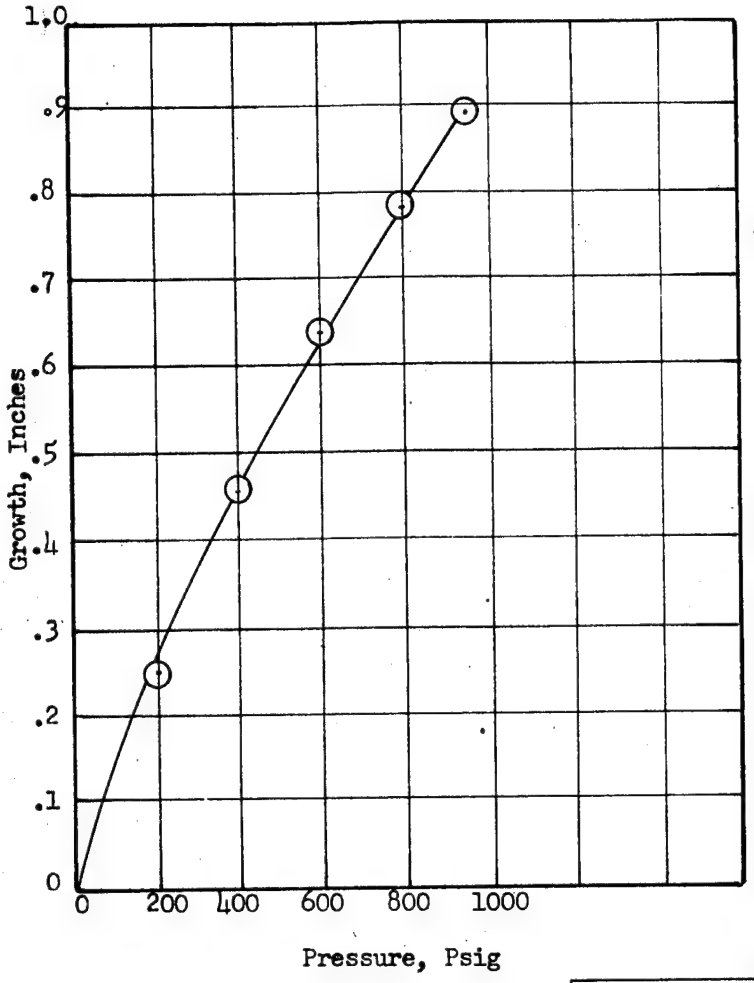


Pressure, Psig	Skirt-to-Skirt Growth, Inches				
	2	3	4	5	Avg.
0	0	0	0	0	0
100	.17	.18	.19	.15	.17
200	.38	.39	.44	.36	.39
300	.54	.57	.59	.53	.56
400	.73	.78	.78	.72	.75
500	.94	1.00	.97	.91	.95
600	1.11	1.20	1.16	1.10	1.14
700	1.31	1.41	1.33	1.31	1.34
800	1.50	1.63	1.52	1.50	1.54
900	1.70	1.84	1.73	1.71	1.75
946	1.77	1.92	1.81	1.81	1.83

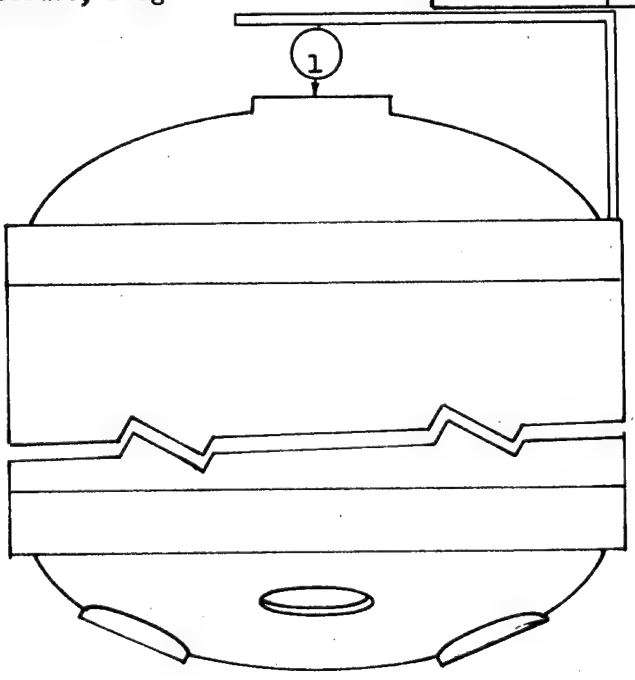


Longitudinal (Skirt-to-Skirt) Growth of the Chamber

Figure 2

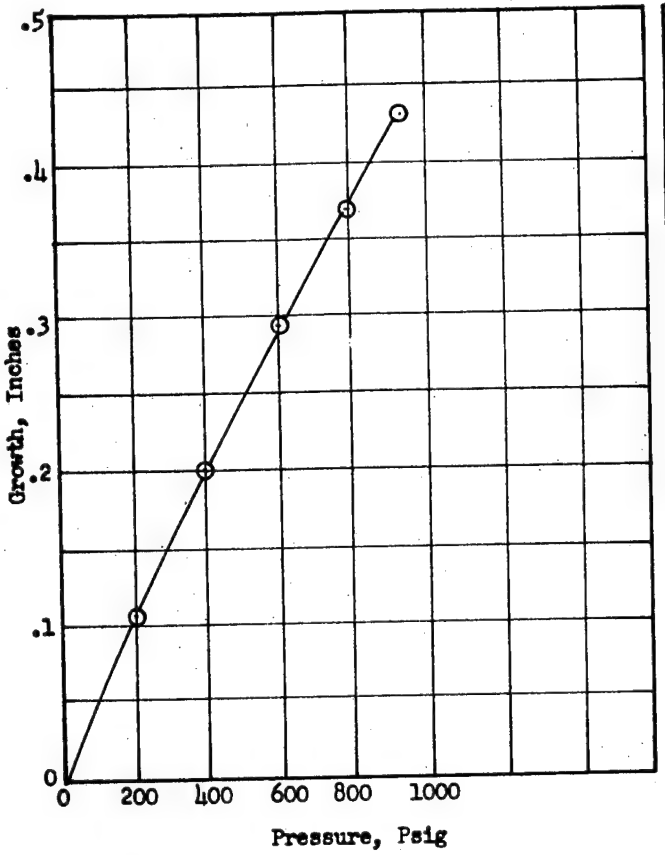


Pressure, Psig	Fwd.-Dome-to-Skirt Growth, Inches				
	1				
0	0				
100	.18				
200	.25				
300	.38				
400	.46				
500	.54				
600	.63				
700	.71				
800	.78				
900	.86				
940	.89				

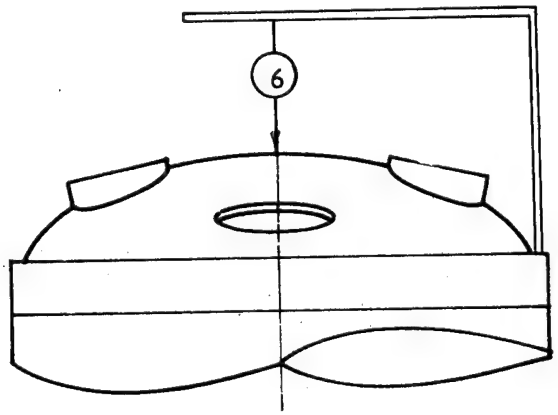


Forward Dome-to-Skirt Growth

Figure 3

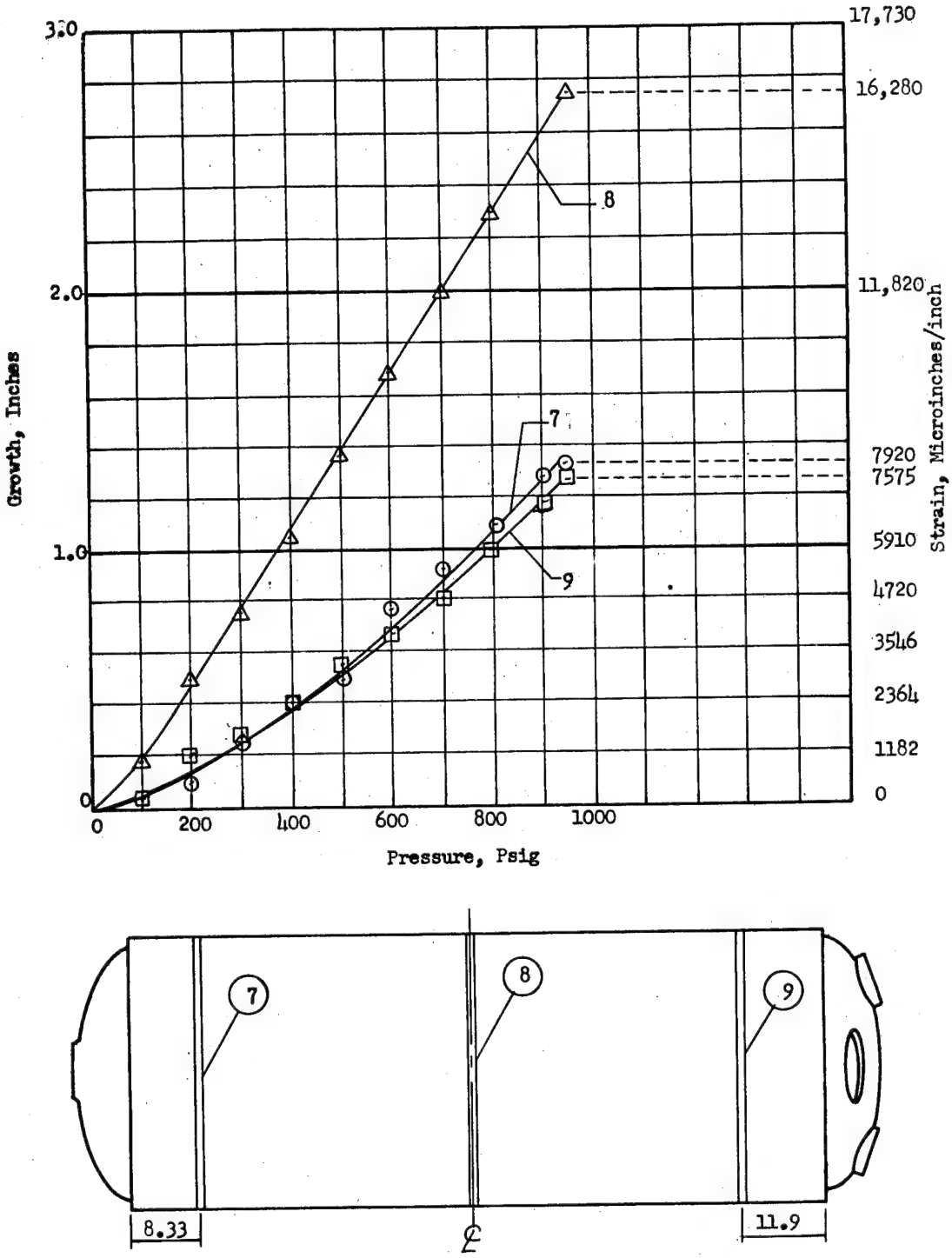


Pressure, Psig	Aft Dome-to-Skirt Growth, Inches				
	6				
0	0				
100	.05				
200	.11				
300	.15				
400	.20				
500	.24				
600	.29				
700	.33				
800	.37				
900	.41				
940	.43				



Aft Dome-to-Skirt Growth

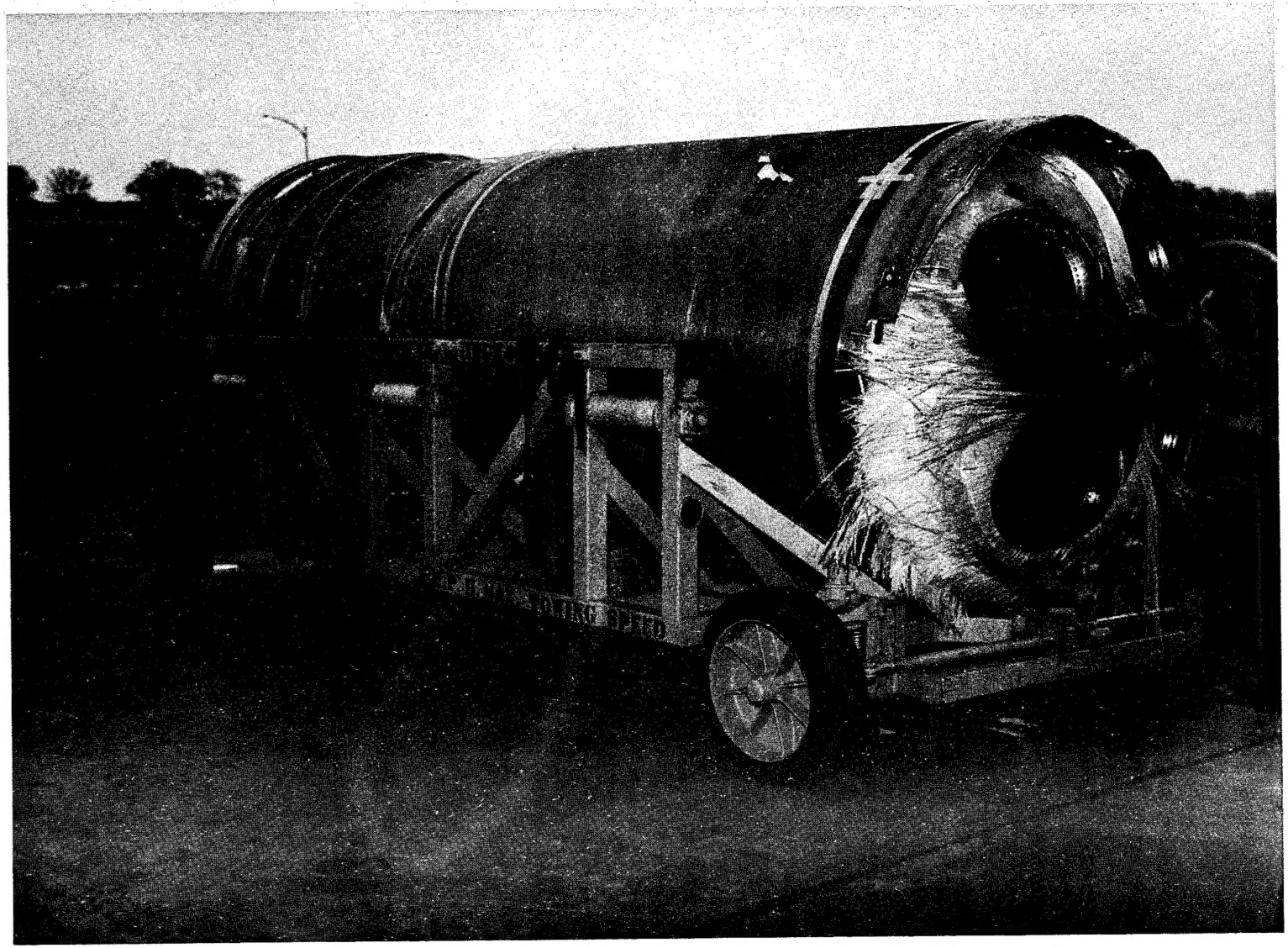
Figure 4



Circumferential Growth Data

Figure 5

Figure 6



Ruptured Chamber (Photograph No. 1-63S 00016)

APPENDIX

DEFLECTION DATA

TABLE 1

DEFLECTION DATA

AGC 3-067-610

APPENDIX

Test No. 678P

12-29-62

69 STU

S/N 7170411

Burst Phase

Pressure vs Deflection - Inches

PREPARED BY: Tom Ikesaki

CHECKED BY: F. E. S.

DATE:

AEROJET-GENERAL CORPORATION

SOLID ROCKET PLANT

PAGE 1 OF 1

REPORT NO.

MODEL NO.

Deflec. Position	1	2	3	4	5	6	7	8	9		Time							
PSIG											(Sec.)							
0	0	0	0	0	0	0	0	0	0		0							
100	.18	.17	.18	.19	.15	.05	0	.18	.04		20.0							
200	.25	.38	.39	.44	.36	.11	.09	.49	.20		29.5							
300	.38	.54	.57	.59	.53	.15	.24	.76	.27		39.8							
400	.46	.73	.78	.78	.72	.20	.41	1.06	.40		48.0							
500	.54	.94	1.00	.97	.91	.24	.59	1.38	.56		57.2							
600	.63	1.11	1.20	1.16	1.10	.29	.77	1.69	.67		66.4							
700	.71	1.31	1.41	1.33	1.31	.33	.93	2.00	.81		76.0							
800	.78	1.50	1.63	1.52	1.50	.37	1.10	2.30	1.01		85.8							
900	.86	1.70	1.84	1.73	1.71	.41	1.29	2.61	1.19		95.1							
940	.89	1.77	1.92	1.81	1.81	.43	1.34	2.75	1.28		101.0							
940 > Burst	.87	1.77	1.90	1.77	1.77	.43	1.34	2.75	1.28		119.4							

AEROJET-GENERAL CORPORATION
Sacramento, California

T. No. 3-1251

Date 10 July 1963
DHM:ecs

TRANSMITTAL OF TECHNICAL INFORMATION

TO: SMUPA-VP3
Plastics Technical Evaluation Center
Picatinny Arsenal
Dover, N. J.

VIA:

REFERENCE(S): (a). Request for Reports R14416 - Items 1. and 2.

ENCLOSURE(S): (1). Report B-235, "Burst Test of a First-Stage POLARIS A3 Filament-Wound Configuration-X Chamber," 15 February 1963.
(2). Report B-238, "Burst Test of a First-Stage....," 15 February 1963.

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Very truly,

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D. J. Bedsole, Mgr.